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The Dynamics of the Gender Earnings Gap for College Educated Workers: The Child Earnings Penalty, Job Mobility, and Field of Study

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Abstract

This paper uses a rich set of administrative data to examine the dynamics of the gender earnings gap for college graduates from 2010-2020 in Ireland. We focus on the dynamics of the gap in the first 10 years of the working career, what this looks like, what determines it and what can explain the patterns. We examine the extent to which changes in job mobility after childbirth can explain the dynamics of the gender earnings gap across fields of study. Our findings suggest that the fact that men experience much higher earnings gains than women, particularly within jobs, is the key driver behind the observed earnings divergence. This is particularly evident among women who have studied Business or Law in University. Changes in job mobility after childbirth are not a major contributor to the divergence in earnings but analysis of household survey data suggests that reductions in hours of work following childbirth explains approximately 60% of the initial decline in female weekly earnings and much of the male-female earnings gap in the years after childbirth.

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Introduction

Gender differences in wages and earnings are particularly pronounced among top earners, a feature that is observed across many countries (OECD (2012)). A number of theories have been put forward to explain these differences, including differences in human capital, changing labour force participation after childbirth, differences in the opportunities available for career advancement through job mobility (job-shopping), and psychological differences related to risk-taking and competition (Albrecht et al. (2003); Manning and Swaffield (2008), Bertrand et al. (2010), Bertrand et al. (2019) Altonji and Blank (1999)).

In this paper we use a rich administrative data set that matches details on both second level and third level education, with administrative data on earnings to examine the earnings dynamics of college educated workers in Ireland. We look at college graduates who graduate after 2010 and track earnings for up to 10 years after graduating. We focus on the dynamics of the gap over the first 10 years of the working career, examining what this looks like, what determines it and what can explain the patterns.

We find that these men and women start off with almost identical weekly earnings in the year after graduation, but earnings diverge substantially in the years following graduation, with the earnings of men exceeding those of women by 20% on average 10 years after graduation. This is particularly true for women with children, who see their earnings fall 40% below those of men 10 years after graduation. The wage divergence is associated with a substantial reduction in earnings in the year following childbirth, particularly for graduates of Business and Law. We find that that differences in job mobility explain very little of the wage divergence. Instead, supplementary analysis using survey data indicates that reduced hours of work following childbirth can directly explain up to 60% of the reduced earnings following childbirth.

Previous work has looked at whether worker-firm interactions can explain this pattern. For instance Albrecht et al. (2018) use Swedish data to examine if firm to firm mobility can explain the patterns. They find little gender difference in firm-to-firm mobility. The main driver of the gender difference in their study is that men experience higher wage gains than women both as switchers and as stayers. Likewise Manning and Swaffield (2008) examined early career growth and find that even after controlling for human capital, job-shopping and "psychological" theories a substantial unexplained wage growth gap remained.

Another strand of this literature focuses on the extent to which differences in subjects studied at undergraduate level can explain differences in wages between men and women. Brown and Corcoran (1997) and Machin and Puhani (2003) find that these differences can explain a non-trivial portion of the wage gap. However, they only look at the gender wage-gap at a point in time and not on the dynamics of the gap over the career. Recent work extends this approach by examining if the child wage penalty for college educated women differs across fields of study (Goldin and Katz (2008), Goldin (2014), Butikofer et al. (2018)). The underlying hypothesis is that that some sectors are more prone to non-linear wage structure than others which entails a more serious penalty for time out. Butikofer et al. (2018) find some evidence of this in that that the gender earnings gap for Business and Law graduates is around 30% but substantially less for STEM and Health graduates 10 years after childbirth.

We contribute to this literature in a number of ways. We extend previous work on the gender wage gap in Ireland. Callan et al. (2000) examine the gender wage gap in Ireland from 1987 to 1994. They focus on all employees and find that in 1987 the female to male wage ratio was approximately 0.8 in 1987 and rose to 0.83 in 1994. Furthermore, they find that in 1987 about half the gender wage gap was due to differences in characteristics, while in 1994 around three quarters

of the gap can be attributed to differences in characteristics. Doris (2019) provides a more recent survey of the gender wage gap in Ireland, focusing in particular on how the wage gap varies across the distribution. However, as with previous work she uses cross-sectional data and cannot examine the dynamics of the gender gap over the life cycle, which has been shown to be important in the international literature. We are the first to explicitly examine the child earnings penalty for mothers in Ireland. We further extend the international work by combining the two earlier literatures by examining heterogeneity in firm-to-firm mobility across fields of study and analysing the extent to which the interactions of firm mobility and motherhood differ across areas of study. In particular we examine the extent to which changes in firm mobility observed after childbirth differ across sectors and to what extent these differences explain the differences in earnings dynamics across these sectors. Finally, we supplement the analysis of the administrative data with an analysis of a longitudinal household survey, which allows us to examine the role of hours of work in explain the gender earnings dynamics. This allows us not only to look at the hours reductions, but also to examine differences in non-linear work schedules between mothers and fathers in the years after childbirth.

Our findings reinforce the potential gender benefits associated with reorganising work practices in fields such as Business and Law. Women make up a large share of graduates in these fields, have better high school grades entering university and obtain better university grades. Wages are similar after graduation; however women suffer a large and lasting penalty associated with reduced hours following childbirth. The growth in working from home and associated technological changes have the potential to lessen the female penalty associated with childbirth. However, as long as non-standard non-social hours continue to be rewarded in areas such as

Business, further reductions in the gender wage gap will require a reallocation of time within households, either through changing preferences or changing social norms.

1. Methodology

To examine the role of childbirth on earnings we follow the event-study approach adopted by others in this literature (Albrecht et al. (2018), Butikofer et al. (2018); Kleven et al. (2019),). Let t = 0 represent the time when an individual becomes a parent, which may happen at any time between 2010 and 2020, given our data and sample. In our sample t runs from -10 to +9. Index all years relative to year t = 0. Letting y_{ist} denote the outcome of interest for individual i, in year s at event time t, we estimate the following event-study specification:

$$y_{ist} = \sum_{j \neq -1} \delta_j I[j = t] + \sum_k \beta_k I[k = age_{is}] + \sum_h \beta_h I[h = s] + \varepsilon_{ist} \qquad (1)$$

In addition to the set of event time dummies, we include age dummies and year dummies to control nonparametrically for underlying life cycle and time trends. The inclusion of a full set of year dummies controls for time trends such as business cycles. We can identify all the effects because conditional on age and year, there is variation in event time driven by the age at which the woman has her first birth.

2. Data

The Educational Longitudinal Database (ELD) is a framework for analysing graduate outcomes and learner activities in Ireland. It uses matching across a range of pseudonymised administrative data sources. The education data are taken from three main sources. The

information on second level education is mostly taken from the post-primary online database (PPOD) and records details on all students entering second level education. This contains information on secondary school type including fee-paying status and whether the school is single-sex or coeducational. It also contains detailed secondary school small area deprivation indices. All students in Ireland who complete second level education take a standardised state examination, called the Leaving Certificate. Students are typically examined on between 7 and 9 subjects. The scores on the best 6 subjects are used to determine entry to university. Information on Leaving Certificate results in the ELD are taken directly from the State Examinations Commission and are therefore free of measurement error typically associated with self-reported grades. Information on third-level education is taken from the Higher Education Authority data and contains information on course name, grade, field of study, year of graduation and institute.

Table 1 provides the distribution of students by gender across broad fields of study. Business and Administration is the most popular field of study and both men and women are well represented in this area. Men are overrepresented among Engineering and IT students, while women are overrepresented among students in education, nursing and social care.

The earnings data used in this study are taken from the Revenue payroll data (PMOD). This includes information on average weekly earnings, for up to three jobs along with total earnings. In addition, it contains the NACE code of the employer along with an anonymised employer ID which allows us to track firm to firm mobility. Finally, we have access to Department of Social Protection data on state payments including unemployment benefits, disability benefits and maternity benefits. The match rate rates across these data are very high accounting for more than 90% of all Irish HEA graduates. Although there is no definitive indicator of emigration

available in the administrative data sources, most of those non-matched are assumed to have emigrated.[1]

For our analysis we were provided with a 66% random sample of the total data. This reflects CSO guidelines in relation to data minimisation requirements of GDPR legislation. However, prior to the detailed analysis with the 66% sample we also conducted preliminary work with the full 100% sample and obtained similar results. This is to be expected given the random sampling used to produce the smaller sample.

We use the matched Department of Social Protection (DSP) data to create an indicator variable for year of childbirth. In particular we use receipt of maternity benefits as recorded in the DSP data to indicate the birth of a child. In Ireland, women who have paid the required social insurance contributions (typically 39 weeks of insurance contributions paid in the 12-month period before the first day of maternity leave) are entitled to twenty-six weeks of paid maternity leave and a further sixteen weeks of unpaid leave. The main reasons a woman may not qualify for paid maternity leave are inadequate social insurance contributions or having left employment more than 16 weeks before the birth of the child. Lack of knowledge of entitlements or of the application procedure may also contribute to non-take up. Russell et al. (2011) carried out a survey of mothers to understand the work experiences of women who had a baby between July 2007 and 2009. They find very high take up of paid maternity benefit, with 95 percent of the mothers with a university degree reported having taken paid maternity leave at the time of the pregnancy. [2] Consequently our use of maternity benefits to identify childbirth for mothers is likely to capture almost all births in our data. In a later section of the paper, we also use receipt of paternity benefits for fathers to

[1] See https://www.cso.ie/en/releasesandpublications/ep/p-heo/highereducationoutcomes-graduationyears2010-2019/whatdograduatesdo/

[2] We find similar take up rates in the Growing up in Ireland Infant Cohort Wave 1 used in Section 4.2.

identify birth of a child for the men in our sample. Unfortunately, the data on fathers relies on claiming paternity benefits and in contrast to mothers not all fathers do so.[3] In addition, paid paternity leave was only introduced in Ireland for children born or adopted on or after September 2016. Therefore, when looking specifically at fathers we must restrict the analysis to those who graduated after 2015.

Our overall sample consists of 87,326 women and 69,271 men. Using the information on maternity leave we estimate that 6,812 (7.8%) of the women in our sample had at least one child during the time we observe them. The distribution of births by year since graduation is given in Table 2. 46.8% of the mothers in our sample had their first child within 5 years of graduating.

While the administrative data allow us to carry out a detailed longitudinal analysis of the gender gap in weekly earnings these data contain no information on hours of work. To supplement the analysis of the administrative data we also use data from the Growing up in Ireland Infant Cohort. This is a longitudinal study that began in 2008 (Wave 1) and collected data on over 10,000 9-month-olds and their families. Follow up surveys were completed when the child was aged 3 years (Wave 2), 5 years (Wave 3), 7/8 years (Wave 4) and 9 years (Wave 5). Crucially the 2008 survey also asked some retrospective questions on the mother's labour market circumstances prior to the birth of the child. In particular we can determine weekly hours of work in the year prior to childbirth and in all subsequent waves, which we use to complement the earnings analysis from the administrative data.

[3] Analysis by the Central Statistics Office of Ireland shows that in 2019 that rate of paternity benefit was 60% that of maternity benefit.
https://www.cso.ie/en/releasesandpublications/er/eampb/employmentanalysisofmaternityandpaternitybenefits2016-2019/#:~:text=Maternity%20benefit%20was%20paid%20to,%2C%20(see%20figure%202).

3. Results

4.1 HEA Administrative Analysis

We begin by looking at the male-female difference in log weekly earnings in the 10 years following graduation for all those with at least a level 8 qualification (university degree). The results are given in Figure 1 which plots the estimated earnings differential along with 95% confidence intervals. Looking first at all graduates, we see that the gender gap is very small immediately after graduating but increases to almost 20% 10 years after graduation. However, the pattern is very different when we compare all men to women with children, and all men to women without children. For both groups the gap is almost zero after graduation and while it increases to 18% for women without children, the increase is much larger for women with children. 10 years after graduation women who have had a child during this period can expect to earn almost 40% less than men. Figure 2 summarises the same information in a slightly different format by plotting the year-on-year growth rate in weekly earnings each year after graduating. In addition, it plots the growth rates separately by field of study at third level. Looking at the plot for all workers we see a substantial gap of about 2 percentage points in favour of males in each year after graduation. There is some evidence that gap varies by field of study at university, with the gap being particularly evident in Business, Law and Health and less evident in Education and STEM. This is consistent with Butikofer et al. (2018) who found large gender earnings gap for Business and Law graduates in Norway but substantially smaller gaps for STEM graduates and Bertrand et al. (2010) who looked at MBA graduates from a top US business school and fond that, while at the start of their careers male and female MBAs had nearly identical incomes, the earnings soon diverged with male annual earnings advantage reaching almost 60 log points 10 to 16 years after graduation,

Our rich data allows us to estimate the earnings gap including controls for human capital including leaving cert points and grade awarded at university. Several authors, including Elsner and Isphording (2017) and Delaney and Devereux (2021), argue that rank in high school is an important determinant of future outcomes, even conditional on prior test scores. Therefore we control for both rank in both secondary and rank in their college course. In addition, we control for background characteristics such as whether or not the students attended a fee-paying school at second level. Summary statistics for these variables by gender are given in Table 3. We see that females score higher in the leaving certificate examination and also are more likely to receive higher grades in university, so these measures of human capital will reinforce rather than reduce the gender gap. However, males are much more likely to attend a fee-paying school than females, so that any private school wage premium will exacerbate the underlying gender gap in wages.

The gender gap conditional on these controls is given in Figure 3 and shows a similar trend to that without controls. Looking at all workers we see that by including the controls the male advantage is roughly 5% after graduation but increases to 12% 10 years later. However, for mothers the male premium is almost twice as high at 23% 10 years after graduation (down from 37% without controls). Thus, while controls explain some of the divergence in earnings between men and women, these results suggest that much of the action reflects from what is happening in the labour market rather than simply reflecting returns to prior achievement.

Given the sizeable effect for women with children we next explore the child penalty around time of first birth for women. Using standard event study type analysis (Kleven et al. (2019)), and using log weekly earnings, we estimate the event study regressions specified in equation (1) for women, focusing on the birth of their first child. The resulting event study diagrams are given in Figure 4. Looking at the results for all women who have had a child at some stage during the

follow up period, the event study analysis shows a clear discontinuous drop in earnings of about 25% in the year following first childbirth. Furthermore, these earnings continue to fall in the years after birth, so that 6 years after the birth of the first child women's earnings are 30% lower than the year prior to birth. In line with Goldin (2014) we then looked at the extent to which this drop varies by field of study. We find relatively small declines in Education and STEM but larger and persistent drops of up to 30%-60% in Business and Law.

Figure 5 shows the results when the sample of mothers is grouped by prior attainment on the Leaving Certificate. As before we see large and persistent drops in earnings for both higher and lower achieving women, reinforcing the view that this penalty is reflecting labour market dynamics rather than simply selection. We also found a similar persistent reduction in earnings when we restricted the sample to look at first-time mothers who only had one child throughout the sample period. Therefore, the persistence in the earnings reduction does not seem to reflect the effect of later births.

A similar analysis of the child penalty for fathers is provide in Figure 6, using receipt of paternity benefits to identify birth of a child for the men in our sample. Unfortunately, the data on fathers relies on claiming paternity benefits and in contrast to mothers not all fathers do so. Furthermore, paid paternity leave was only introduced in Ireland for children born or adopted on or after September 2016. Therefore, we must restrict the analysis for fathers to these later years of graduation. As a result, we are much less confident in these results. For comparison Figure 6 we include the event study estimated for mothers over the same period. The estimated child penalty for these mothers is 23%, which is very similar to the 24% estimated on the larger sample. However, in contrast to the results for women, we find no evidence of a child penalty for fathers. The change is weekly earnings at time of first birth is almost zero. Although we are reluctant to

over emphasise the analysis of fathers, the result is consistent with the international evidence and suggests that childbirth may be a significant explanation of the diverging earnings trends for male and females shown in Figure 1.

One possible explanation put forward in the literature for the large child-penalty concerns job-shopping (Manning & Swaffield, 2008). Topel and Ward (1992) found that one third of wage growth in the US in the first 10 years of labour market entry is due to job mobility. If childbirth alters job mobility for women and reduces the chances of women moving to better paying jobs, then this may feed into lower wage growth and explain the child penalty observed earlier. To begin to examine this, we estimate event studies similar to those estimated using earnings as the dependant variable, except this time we use an indicator of whether the individual changed employer relative to the previous year. Our information on employer comes from revenue data and therefore provides a clean, accurate measure of job changes. The results, given in Figure 7, show that in the year following childbirth, women are 5 percentage points less likely to change jobs, with the differences particularly large for those who studied Law. The extent to which differences in job mobility translate into the differences in relative earnings depends not only on the probability of moving but also on the associated premia for moving and staying. Figure 8 shows year on year earnings changes for all men and women, for job stayers and for job switchers. The observed earnings changes associated with job mobility is large and of the order of 20% in the early years after graduation. This would suggest that the reduced mobility of women after childbirth may be important. However, this is offset by the fact that the return to mobility is very similar for men and women. In contrast the earnings gains for stayers are consistently higher for men then women, suggesting that even in the absence of reduced job mobility women's earnings diverge over time from those of men.

To examine this formally we consider a decomposition similar to that used by Albrecht et al. (2018). For each gender (j=M,F) the average log earnings gain from year t to year t+1 can be written as

$$\Delta lnw^{j}{}_{t,t+1} = P^{j}[Switch_{t,t+1}] * [\Delta lnw^{j}{}_{t,t+1}|Switch_{t,t+1}] + P^{j}[Stay_{t,t+1}] * [\Delta lnw^{j}{}_{t,t+1}|Stay_{t,t+1}] \quad (2)$$

By adding and subtracting terms we can write the difference in earnings growth between males and females as

$$\Delta lnw^{M}{}_{t,t+1} - \Delta lnw^{F}{}_{t,t+1} =$$

$$\{P^{M}[Switch_{t,t+1}] * [[\Delta lnw^{M}{}_{t,t+1}|Switch_{t,t+1}] - [\Delta lnw^{F}{}_{t,t+1}|Switch_{t,t+1}]]\}$$

$$+\{P^{M}[Stay_{t,t+1}] * [[\Delta lnw^{M}{}_{t,t+1}|Stay_{t,t+1}] - [\Delta lnw^{F}{}_{t,t+1}|Stay_{t,t+1}]]\}$$

$$+\{[P^{M}[Switch_{t,t+1}] - P^{F}[Switch_{t,t+1}]] * [\Delta lnw^{F}{}_{t,t+1}|Switch_{t,t+1}] + [P^{M}[Stay_{t,t+1}] - P^{F}[Stay_{t,t+1}]] * [\Delta lnw^{F}{}_{t,t+1}|Stay_{t,t+1}]\} \quad (3)$$

To examine the roll of differential earnings gains for switchers versus stayers, we ask what fraction of the observed gender gap in earnings growth between t and t+1, can be explained by the gender gap in earnings gains for switchers, stayers and both. In particular, to examine the roll of earnings gains for stayers we replace the observed earnings gain for women who stayed with the same employer between t and t+1, with the average earnings gain for male stayers over that period. We leave the earnings gains for switchers unchanged and estimate the new gender gap on this transformed earnings series. This equivalent to setting the second term in equation (3) equal to zero, and ignoring differences in the probability of moving, any remaining wage gap is due to the difference in earnings gains for switchers. To examine the roll of differential earnings gains for

switchers we do the same for switchers, while leaving the female earnings gain for stayers at the female level- that is we set the first term of (3) equal to zero. Finally, to examine the overall effect of differential earnings gains we replace the gains for female switchers and stayers with the male average (setting both of the first terms equal to zero). Any additional earnings growth gap that remains after changing both earnings gains is accounted for by differences in mobility between men and women. The results are shown in Fig 9.

The top line in each panel shows the difference between male and female earnings growth each year after graduation. This essentially reproduces the results provided earlier in Figure 2. Looking at the results we see that in each year after graduation men experience earnings growth that is approximately 2 percentage points higher than women. Replacing the earnings gain for female job switchers with the average male gain for switching reduces this gap somewhat but a substantial gap still remains. On the other hand, replacing the earnings gain for female job stayers with the average gain for male stayers leads to a substantial reduction in the gender gap. When female stayers are rewarded in a similar fashion to male stayers the earnings growth gap falls to approximately 0.5 of a percentage point in many of the years after graduation. The last line shows that when both premia are adjusted the gender gap in earnings growth is almost eliminated. These results suggest that gender differences in earnings growth is almost entirely explained by the fact that men experience higher earnings gains than women both as “switchers” and particularly as “stayers”; gender differences in mobility account for very little of the observed gap. The final two graphs reveal a similar trend for women with children and women without children, though the magnitudes involved are much larger for women with children.

The results presented in Figure 4 show that the child penalty was particularly large for those who studied Business and Law at university, while the results presented in Figure 7 showed that

reductions in job mobility, post childbirth, was particularly pronounced in these two areas. As a result, one might expect that job changes play a larger role in explaining the child penalty and subsequent wage dynamics for these two sectors. To examine this, we repeat the earlier decomposition focusing only on Business and Law. The results are given in Figure 10. As before the top blue line shows the gender difference in earnings growth by years since graduation. For those who studied Business or Law, males experience 1 percentage point higher earnings growth in the year immediately after graduation. However, this rises steadily over the life cycle, so that 10 years after graduation males are experiencing annual earnings growth that is 4 percentage points higher than for women. Although our earlier analysis showed that women with children in these sectors were less likely to engage in job changes, the decomposition shows that this is not a significant contribution to the diverging earnings trends. As was the case when we looked at all workers, it is the fact that men experience higher earnings gains than women as stayers that is the key driver behind the observed earnings divergence.

4.2 GUI Infant Cohort Analysis

While the administrative data allows us to carry out a detailed longitudinal analysis of the gender gap in weekly earnings across fields of study, including detailed controls for human capital, and to examine the relative importance of within and between firm changes in explaining the emerging gap these data contain no information on hours of work. Prior work by (Kleven et al., 2019) suggests that changes in hours of work contribute to the rising gender gap in Denmark. To the examine the issue of hours of work and the gender gap we turn to the Growing Up in Ireland Infant Cohort study, which surveys over 11,000 women who had recently given birth. The first survey

took place in 2008, so the timing of the data corresponds closely to the sample used in the administrative data which began in 2010. While the GUI does contain information on total household income it does not separate this by family member so cannot be used to examine the wage penalty. However, the GUI does ask individuals to report their hours of work in each wave. In addition, in Wave 1 mothers are asked to report their labour market status immediately before giving birth and, if working, to report their hours per week. By comparing this to the reported hours of work in the years after birth we can provide some evidence on the extent to which changes in hours of work contributed to the decline in weekly earnings in the years following childbirth.

For comparison with the administrative analysis, we restrict attention to first-time mothers with a university education, who were working prior to childbirth. In the year immediately prior to childbirth these women worked on average 37.78 hours or week. However, this falls to 32.27 hours in the year after childbirth. A simple t-test indicates that the observed fall in hours after childbirth is statistically significant, with a p-value close to zero. The reduction in hours is associated with a large shift into part-time work following childbirth. Prior to childbirth 18.52% of the mothers reported part-time hours but this increased to 45.89% after childbirth. Russell et al. (2018) cite the high cost of childcare in Ireland as a potential barrier to maternal employment, particularly for low-income families. The substantial increase in part-time work we observe is consistent with this.

The 14.5% reduction in hours of work in the year of first birth in our analysis is somewhat smaller than the 24 log-point reduction estimated for MBAs by Bertrand et al. (2010), though some of this difference is likely explained by the very high hours worked by respondents in the US analysis prior to childbirth.

We can use the later waves of the GUI to see to what extent women's hours recovered in the years following childbirth. The third wave of the GUI infant cohort took place in 2013 and the fifth wave of data collection took place between June 2017 and Feb 2018. This allows us to look at hours worked by mothers 5 and 9 years after the birth of their child. In these later waves, hours of work are reported in 5-hour bands. Therefore, to compare across waves we constructed a similar banded hours measure for the wave 0- and 1-hours measures. Figure 11 shows the event study graph for hours of work for mothers who had their first child in 2008. As discussed above we see a sharp drop in hours in the year following childbirth. However, the event-study analysis reveals that, even for women who continued to work throughout this period, hours remained low many years after childbirth.[4] Figure 13, shows the event study graph for hours of work separately by education levels of the partner, where we distinguish between partners with a secondary education or lower and those with a university degree or higher. In keeping with Bertrand et al. (2010) we find that the hours responsiveness of mothers (conditional on employment) was similar across the education levels of their partners.[5]

Although we don't have the hours of work of the fathers prior to childbirth we do know their hours of work in the years after the birth of their child. Figure 12 reproduces the event study hours pattern for women from Figure 11 but adds the average hours of their partners. In the year after childbirth the fathers worked on average 41.35 hours. These hours were maintained in the years after childbirth. Fathers worked 42.96 hours a week on average 9 years after childbirth, compared to an average of 32.6 for mothers, a difference of approximately 30%. Thus, while

[4] As with the earnings reduction the persistent reduction in hours was evident for first-time mothers who only had one child during the sample period, though the smaller sample sizes for this group resulted in large confidence intervals around the point estimates.
[5] Bertrand et al. (2010) did find a larger response on the extensive margin for mothers with higher educated partners.

mothers moved to part-time work in large numbers after the birth of their child and maintained these reduced hours in the years that followed, there was not a similar response from the fathers of the children. This is further illustrated in Figure 14 which shows the distribution of hours worked for mothers and fathers in each of the three waves after childbirth. There is significantly more mass in the histogram above 40 hours for men than women in all waves after childbirth.

As well as the direct proportional effect of reduced hours on earnings, Goldin (2014) argues that women may also suffer indirectly from hours changes in so far as non-linear wage structures in some occupations disproportionately penalises flexible hours in the labour market. In some sectors workers are paid not only according to the number of hours but also when those hours are worked, with an added premium for non-standard hours. This may include over-time at short notice, weekend or evening work. This remains particularly important in sectors such as Business and Law, which we identified as having particularly large gender gaps in the earlier analysis.

The added mass in the hours distributions for men beyond 40 hours suggests that this may be a factor in our analysis. However, we can examine this directly as respondents to the GUI were asked directly to report the extent to which their job involved working evenings or nights and overtime at short notice. 24.85% of the mothers working 9 years after childbirth reported that their job involved working evenings or nights at least once a week, compared to 30.44% of men, while 7.45% of mothers reported that their work involved working overtime on short notice, compared 18.69% of their partners. This difference in irregular work schedules observed in the Irish data is larger than that reported in other countries. Mas and Pallais (2017) report a gender difference of 2.7 percentage points in irregular work patterns in the U.S.. Despite the fact that women with young kids were willing to give up 40 percent of their wage to avoid irregular work, they argue that the small observed differences means that differences in irregular patterns are unlikely to

explain the gender wage gap. The larger differences in the Irish data suggest that this may be a more important issue in the Irish case.

Our data shows that women reduced hours by 14.5% in the year following childbirth. Our analysis of the administrative data shows a 24.4% reduction in earnings in the year after childbirth. Combined, this suggests that the direct reduction in hours can potentially explain approximately 60% of the initial observed child-penalty for women. Furthermore, men are more than twice as likely as women to report having to work overtime at short notice. In keeping with the job-structure hypothesis it seems that both reduced irregular hours may key in explaining the dramatic reduction in female earnings relative to men over the life cycle.

5 Conclusion

This paper examines the divergence in earnings between highly educated men and women in the 10 years following graduation. Women experience a significant penalty for childbirth, with earnings falling by almost 25% in the year following the birth of the first child and bot recovering even 8 years later. As a result, women with children earn on average 40% less than all men, 10 years after graduation. This is true even after controlling for prior human capital achievement. Although childbirth seems to reduce the job mobility of women, we do not find that this is a significant contributor to the divergence. Although earlier analysis showed that women with children were less likely to engage in job changes, the decomposition shows that this is not a significant contribution to the diverging earnings trends. Instead, it is the fact that men experience higher earnings gains than women, particularly as stayers, that is the key driver behind the observed earnings divergence. Analysis of household survey data suggests that a large and

persistent reduction in hours of work can explain approximately 60% of the initial earnings penalty and much of the resulting male-female earnings gap in the years after childbirth.

The growth in working from home and associated technological changes have the potential to lessen the female penalty associated with childbirth. However, as long as non-standard non-social hours continue to be rewarded in areas such as Business, further reductions in the gender wage gap will require a reallocation of time within households, either through changing preferences or changing social norms.

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Table 1 : Percent in each Field of Study by Gender.

	Female	Male	Total
Agriculture and Fisheries	0.72	2.07	1.31
Architecture and Town Planning	0.68	1.70	1.13
Biology and Environmental Science	7.31	6.16	6.80
Business and Administrative Studies	15.93	22.20	18.70
Services	2.79	3.45	3.08
Information and Computers	1.38	8.13	4.36
Creative Arts and Design	6.44	6.01	6.25
Education	8.21	3.34	6.06
Engineering and Manufacturing	2.09	14.86	7.74
Literature and Linguistics	1.86	1.13	1.53
Humanities	13.10	9.93	11.70
Languages	1.78	0.74	1.32
Law	3.61	3.18	3.42
Journalism	0.62	0.52	0.58
Maths/Stats	0.57	1.69	1.06
Medicine/Dental Studies	1.78	1.66	1.73
Nursing Midwifery	9.15	0.98	5.53
Physical Sciences	2.58	3.60	3.03
Psychology	1.84	0.88	1.41
Social Science	4.59	3.93	4.29
Pharmacy	0.73	0.43	0.59
Other Medical	4.34	2.04	3.32
Veterinary	0.28	0.17	0.23
Social Work	7.64	1.21	4.79

Table 2: Distribution of first births by year since graduation.

Year Since Graduation	Frequency	Percent
1	459	6.74
2	602	8.84
3	693	10.17
4	703	10.32
5	731	10.73
6	756	11.10
7	891	13.08
8	804	11.80
9	767	11.26
10	406	5.96
Total	6812	100

Table 3: Summary Statistics by Gender

	Female	Male	Total
LC Points (max 625)	421.19 (109.99)	407.34 (112.56)	415.06 (111.35)
2.1 Honours Degree or better	0.69 (0.46)	0.61 (0.49)	0.65 (0.48)
Rank in High School	55.14 (27.62)	54.70 (27.90)	54.95 (27.75)
Rank in University	48.57 (27.01)	46.98 (27.36)	47.87 (27.18)
Attended Fee Paying	0.10 (.29)	0.15 (0.35)	0.12 (0.32)

Figure 1: Male-Female difference in Log Weekly Earnings.

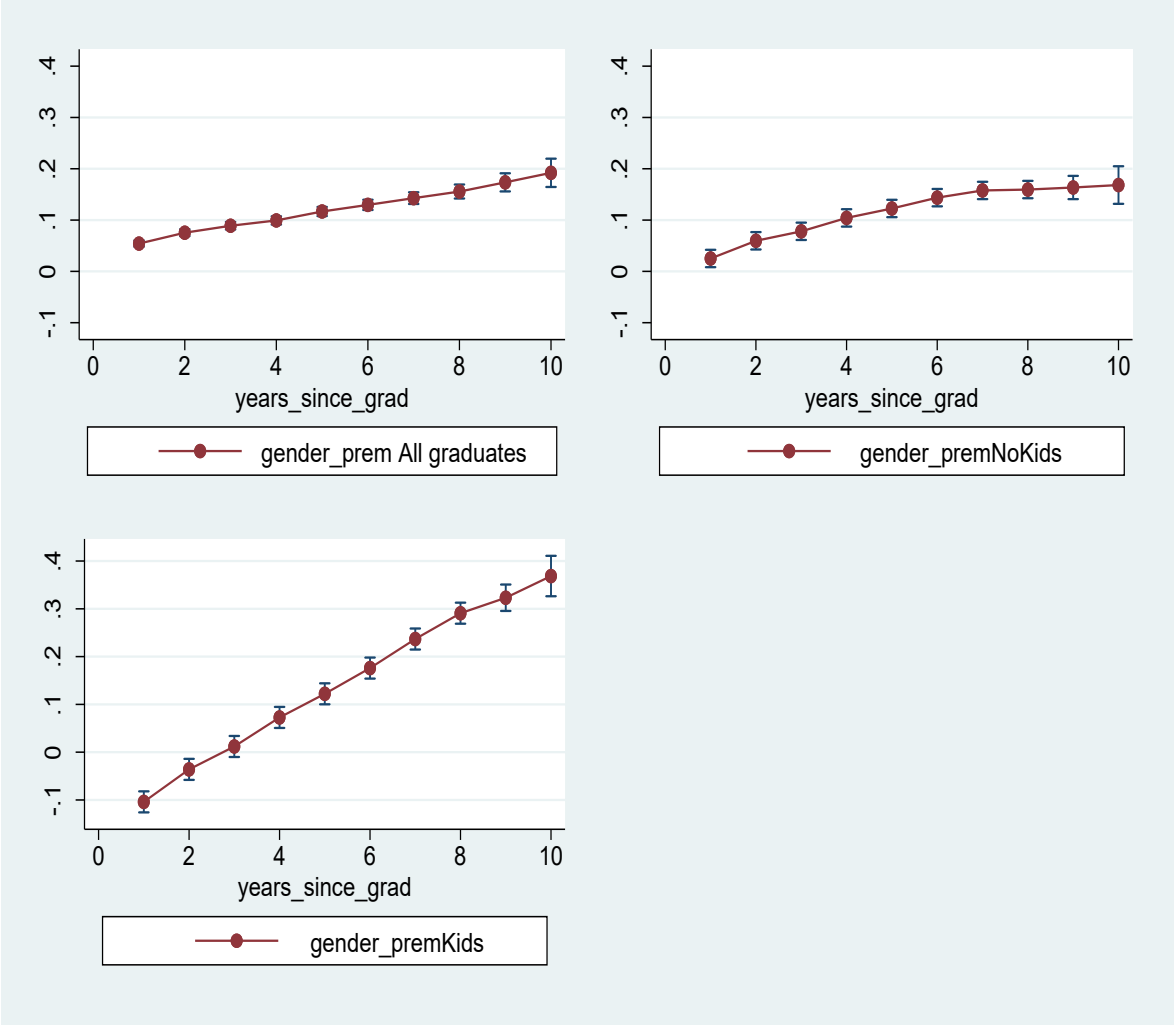

Figure 2: Annual Growth rate in Weekly Earnings by Gender

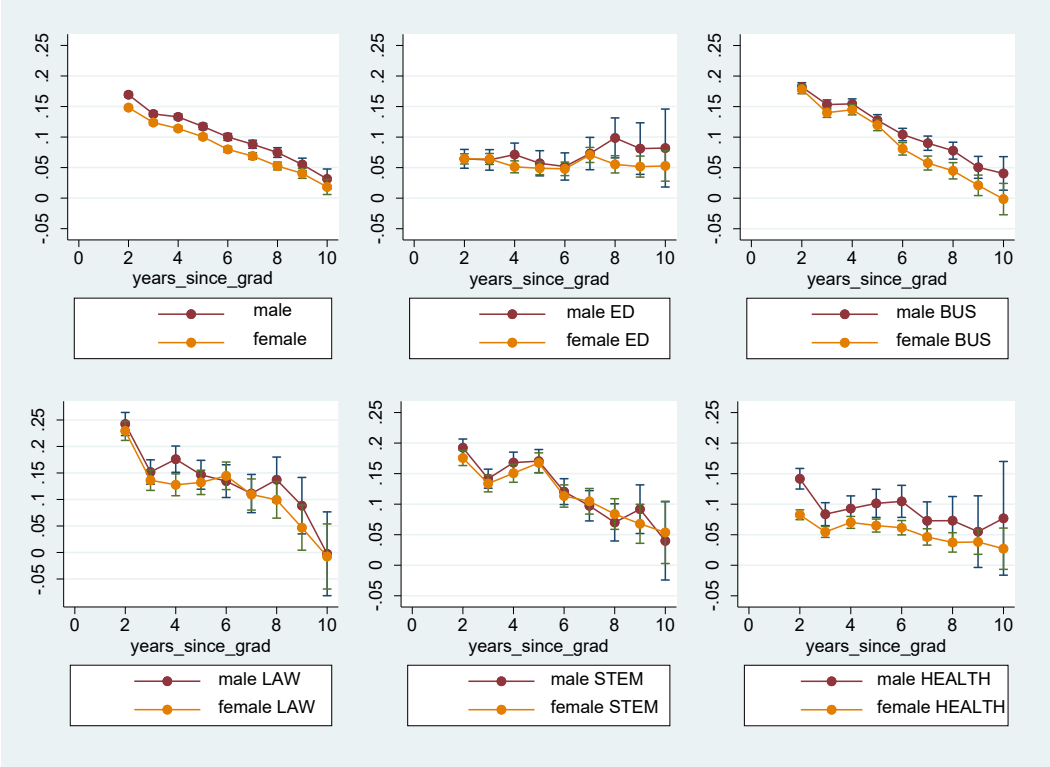

Figure 3: Male-Female Earnings gap with Human Capital controls

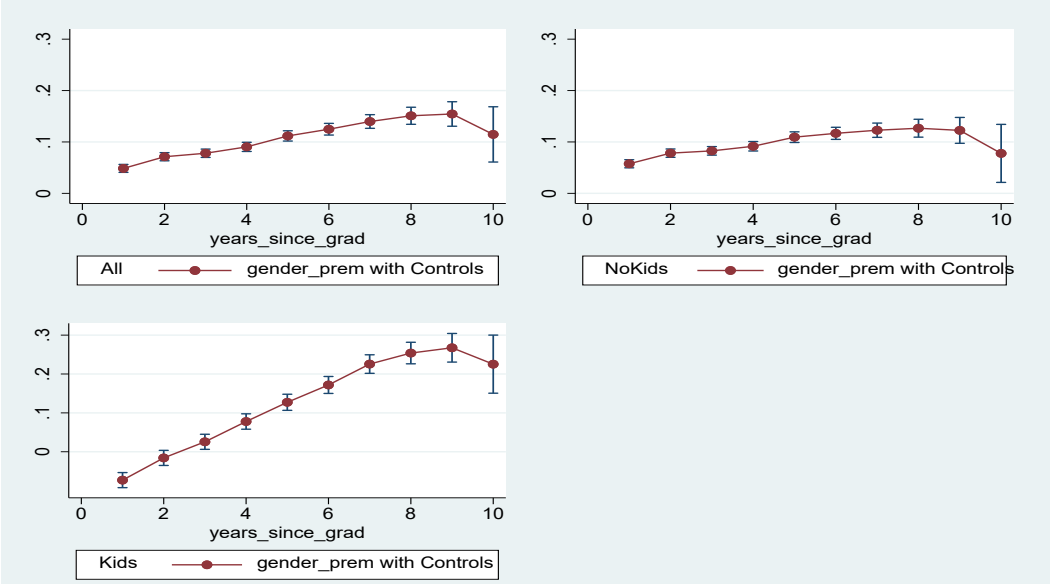

Figure 4: Log Weekly Earnings relative to time of first birth for Mothers.

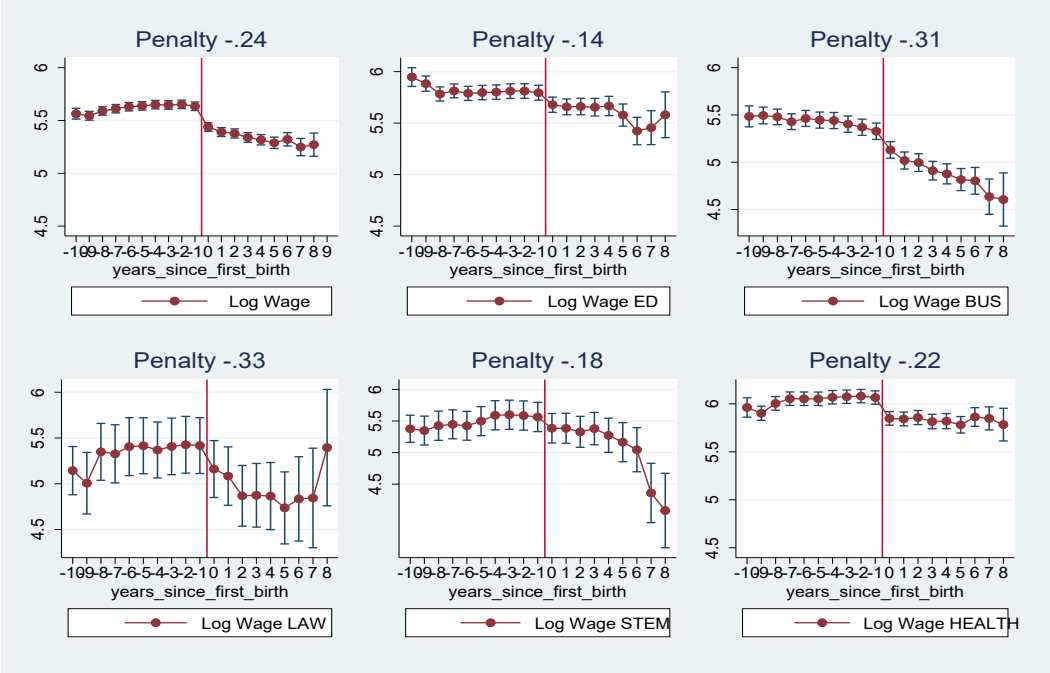

Figure 5: Log Weekly Earnings relative to time of first birth for Mothers by Prior Leaving Certificate Attainment

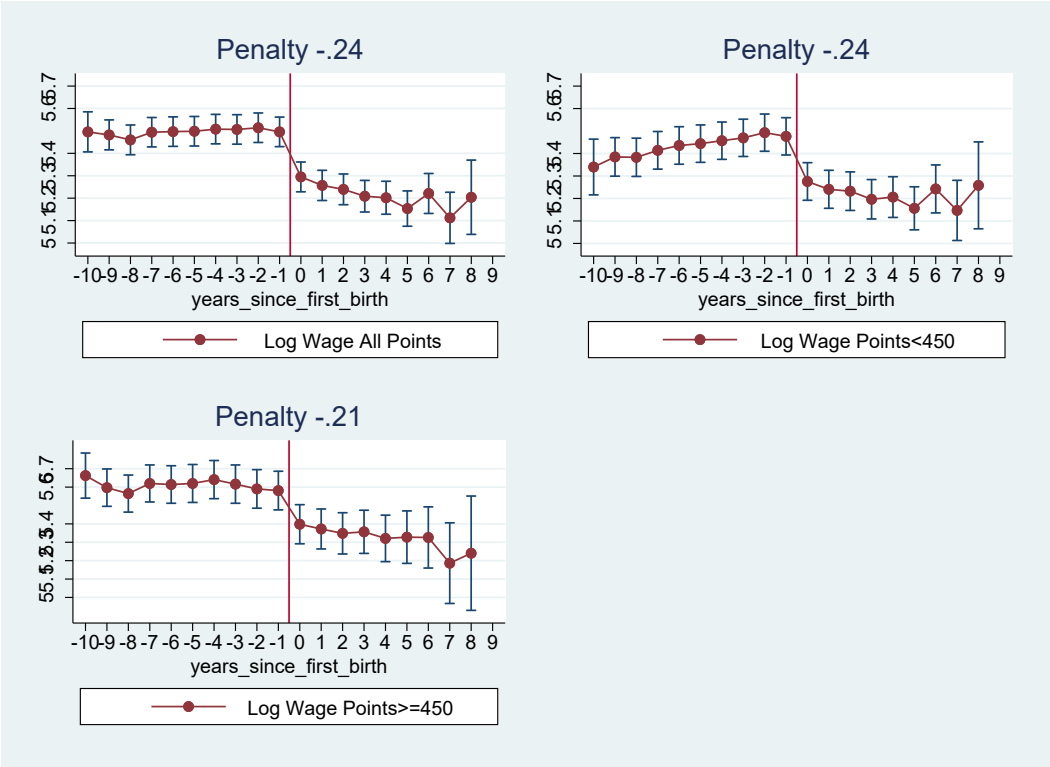

Figure 6: Log Weekly Earnings relative to time of first birth for Mothers and Fathers.

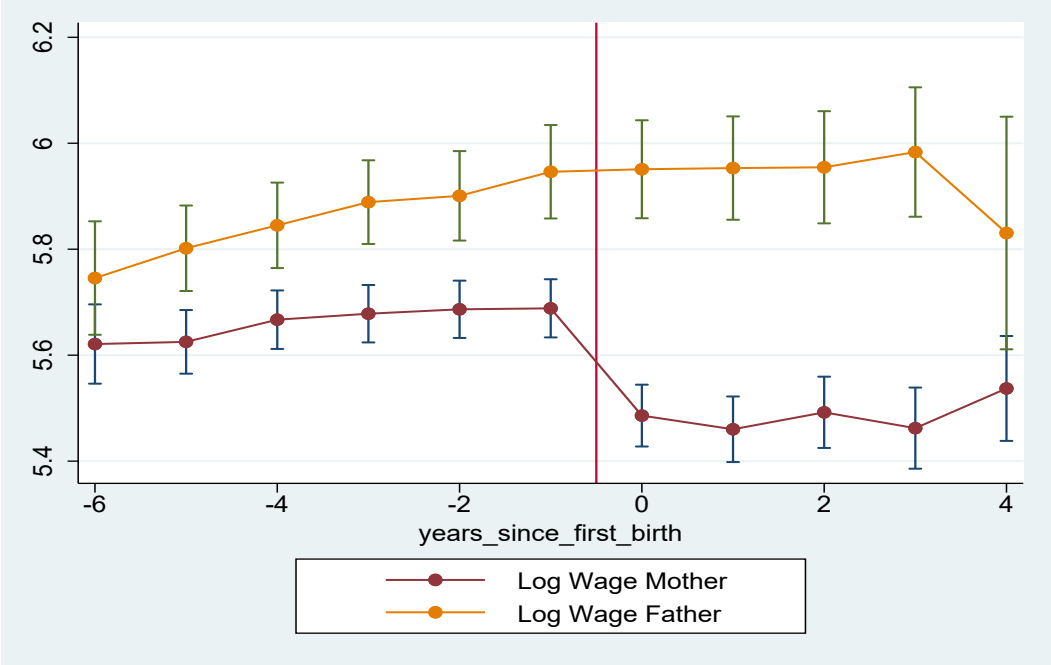

Figure 7: Job Mobility relative to time of first birth for Mothers.

Figure 8: Annual Growth Rate in Weekly Earnings by mover status

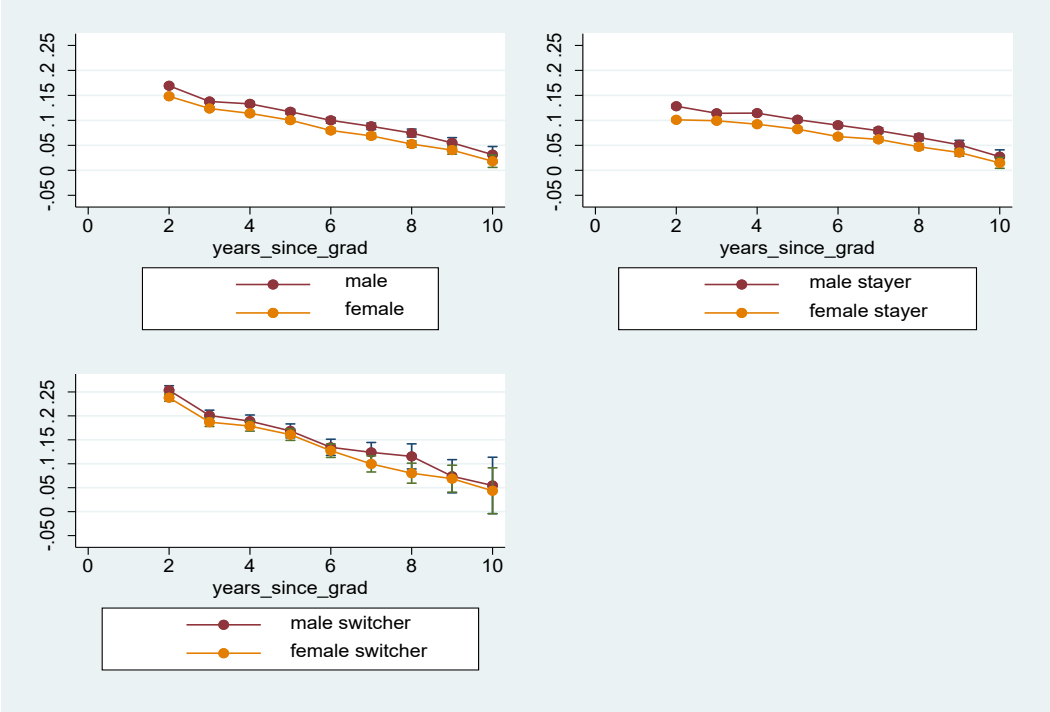

Figure 9: Decomposing Gender Gap in Log Earnings Gains

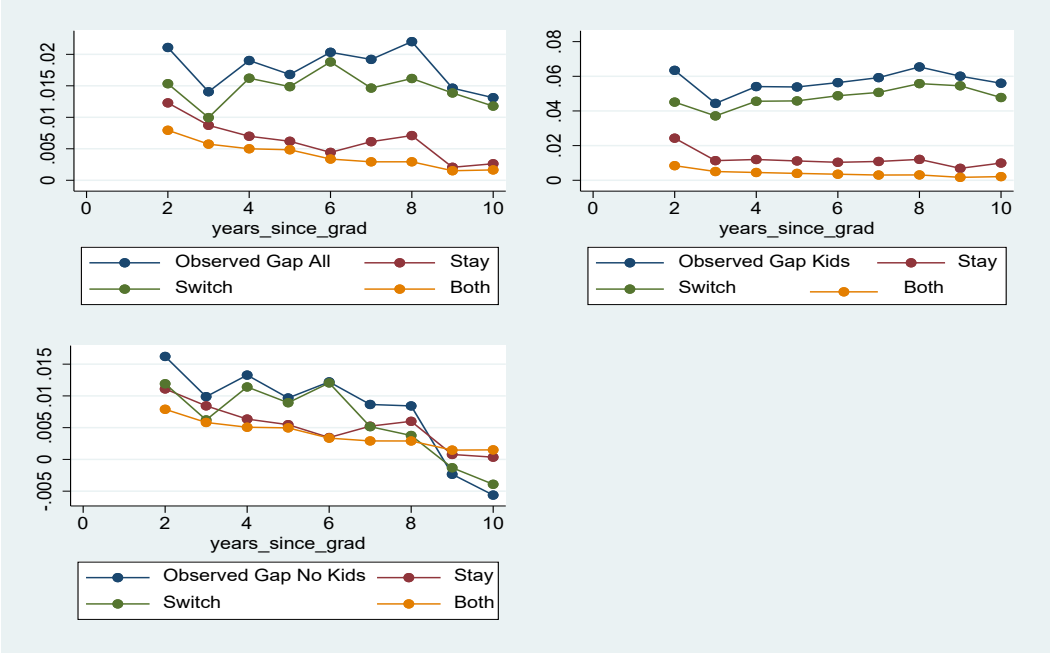

Figure 10: Decomposing Gender Gap in Log Earnings Gains - Business & Law

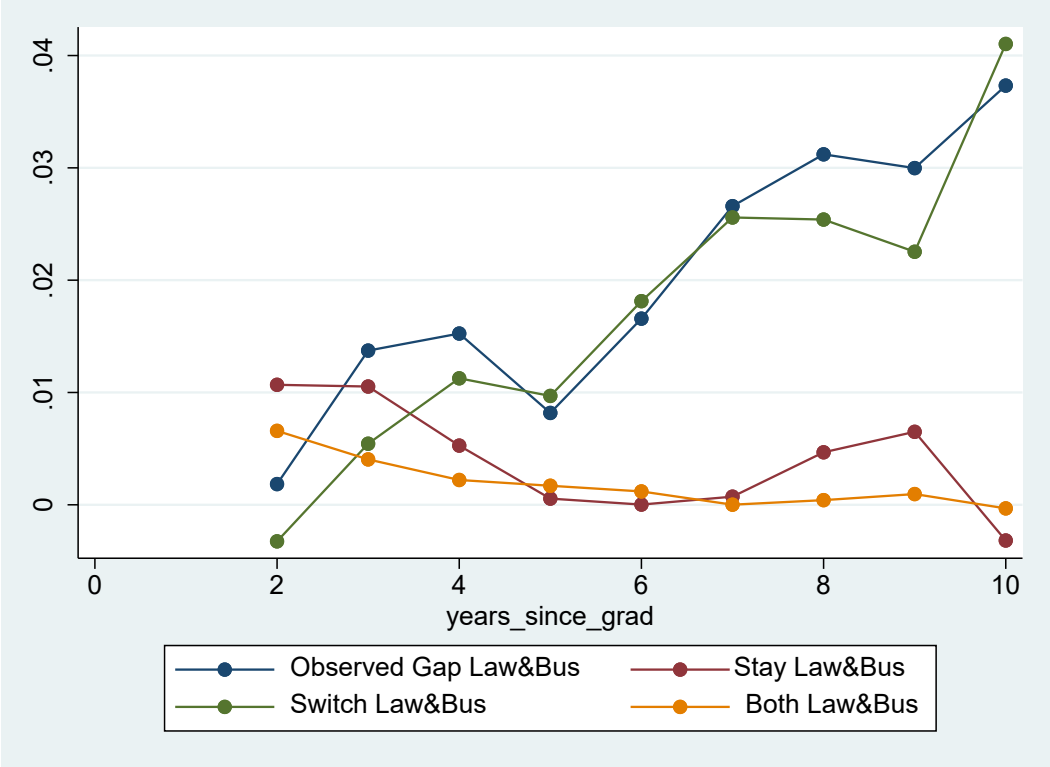
.04
.03
.02
.01
0
0
2
4
6
8
10
years_since_grad
Observed Gap Law&Bus
Stay Law&Bus
Switch Law&Bus
Both Law&Bus

Figure 11: Hours of Work relative to time of first birth for Mothers (GUI Cohort).

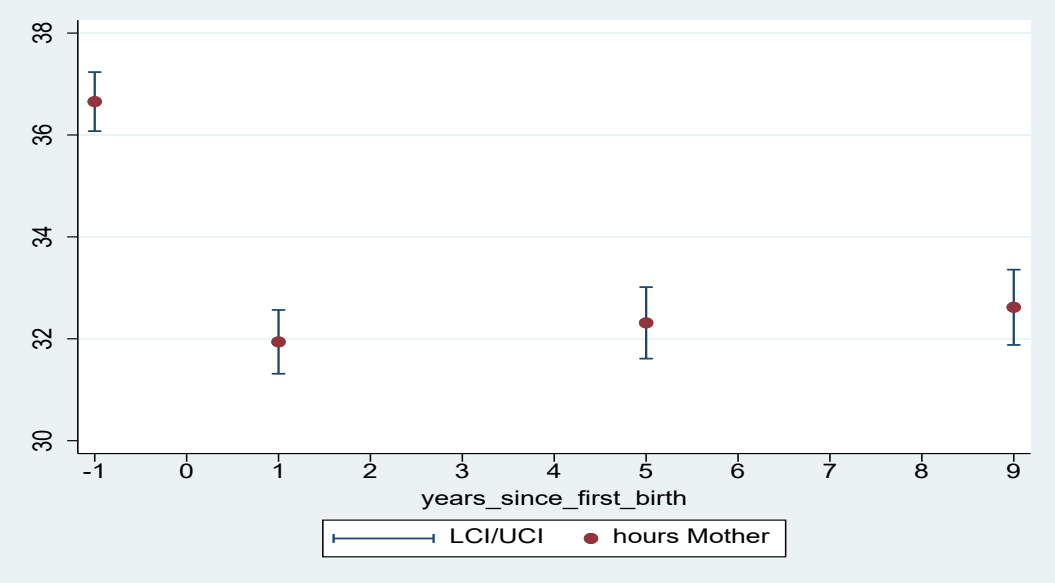

Figure 12: Hours of Work relative to time of first birth for Mothers and Partners (GUI Cohort).

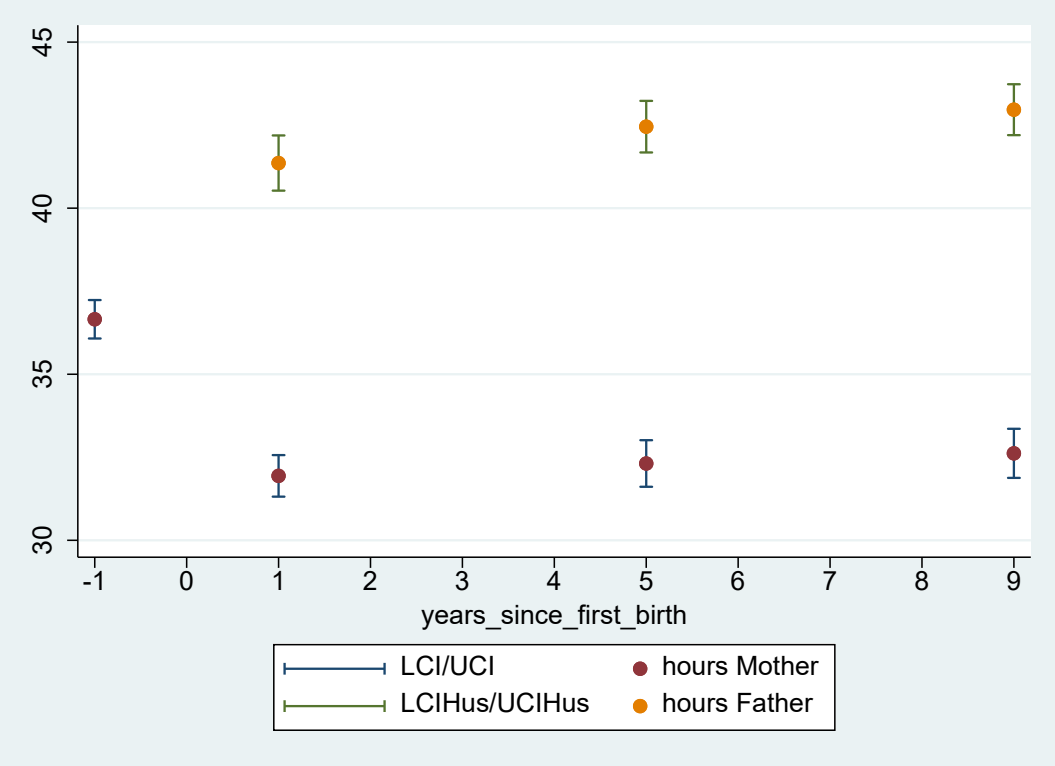

Figure 13: Hours of Work relative to time of first birth for Mothers by Educational Status of Partners (GUI Cohort).

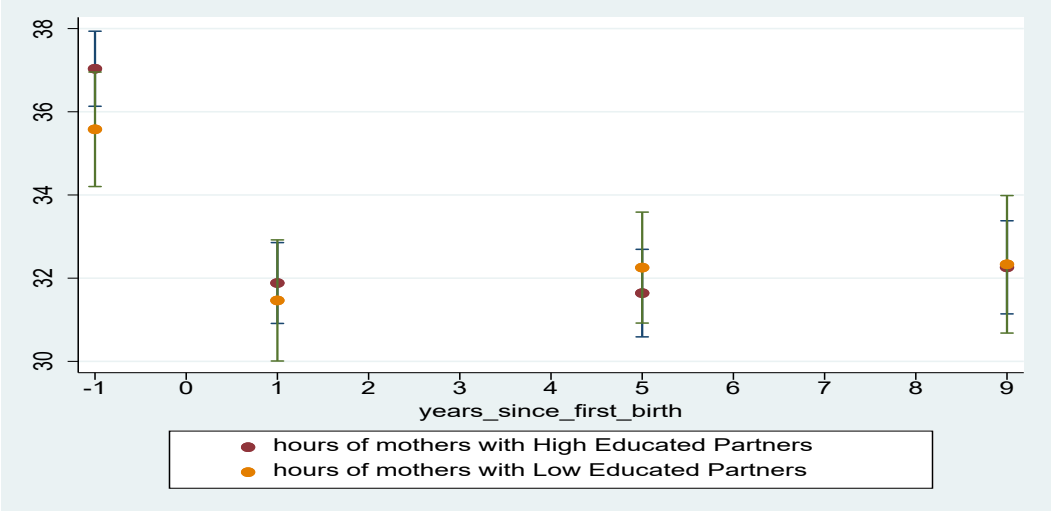

Figure 14: Distribution Hours for Mothers and Fathers Waves 1, 3 and 5 (GUI Cohort).